(Currently Amended) 1. A method of configuring a semiconductor optical amplifier ~~increasing the luminescent bandwidth of a photoelectric semiconductor device by separate confinement heterostructure , the method~~ comprising:

disposing a ~~controlling the widths of different separate confinement heterostructures and producing~~ multi-layer quantum well structure ~~structures~~ comprising multiple layers each having a different luminescent wavelength wherein said multi-layer quantum well structure is disposed between a first and a second separate confinement hetero-structure (SCH) regions ~~widths or constituent materials with the carrier distribution therein is controlled by either electrons or holes~~; and

adjusting a ~~shortening the~~ width of the SCH regions whereby a time for capturing a hole carrier in said multi-layer quantum well structure is substantially equal to a time for capturing an electron carrier in said multi-layer quantum well structure. ~~separate confinement heterostructures in compliance with the mobility of holes, and thereby the time for the electrons to be captured into the multi-layer quantum well structures is approximate to the time for the holes to be captured into the multi-layer quantum well structures~~.

(Currently Amended) 2. The method according to claim 1 further comprising a step of ~~wherein~~:

applying said electron carrier as a dominant carrier. ~~the relationship between time for holes to enter the multi-layer quantum well structures and the time for electrons to be captured by the quantum well structures is satisfactory for the criterion of: |the time for holes to enter the quantum well structures ($\tau_{p,diffusion}$) _ the time for electrons to be captured by the quantum well structure ($\tau_{n,cap}$)| < 1 picosecond~~.

(Currently Amended) 3. The method according to claim 1 further comprising a step of ~~wherein~~::

applying said hole carrier as a dominant carrier.

~~the width of the separate confinement heterostructures is shortened to allow the time for holes to enter the multi-layer quantum well structures to be limited within 5 picoseconds.~~

(Currently Amended) 4. The method according to claim 1 further comprising a step of ~~wherein~~:

disposing a barrier layer between an upper quantum well layer of said multi-layer quantum well structure and a lower quantum well layer of said multi-layer quantum well structure having a different luminescent wavelength from said multiple layers of said multi-layer quantum well structure.

~~the energy levels of the multi-layer quantum well structures is sufficient to provide desirable luminescent wavelengths by stacking multi-layer quantum well structures having different widths or constituent materials.~~

(Currently Amended) 5. The method according to claim 1 further comprising a step of ~~wherein~~:

disposing said first SCH region near a first semiconductor region of a first conductivity type and and second SCH region near a semiconductor of a second conductivity type opposite said first conductivity type.

~~the step of shortening the width of the separate confinement heterostructures in compliance with the mobility of holes is accomplished by shortening the separate confinement heterostructures located in the proximity of a P-type semiconductor side to allow the time for holes to reach the multi-layer quantum well structures to be limited within 5 picoseconds.~~

(Currently Amended) 6. The method according to claim 1 further comprising a step of ~~wherein~~:

providing said different luminescent wavelengths for each of said multiple layers of said multi-layer quantum well structure for spectrally combining said different luminescent wavelengths into a broadband spectrum.

~~at the step of shortening the width of the separate confinement heterostructures in compliance with the mobility of holes, the width of the separate confinement heterostructures in the proximity of a N-type semiconductor side is larger than the separate confinement heterostructures located in the proximity of the P-type semiconductor side, so as to allow the difference between time for holes to reach the multi-layer quantum well structures and the time for electrons to reach the multi-layer quantum well structures to be limited within 3 picoseconds.~~

(Currently Amended) 7. The method according to claim 1 further comprising a step of ~~wherein~~:

providing said different luminescent wavelengths for each of said multiple layers of said multi-layer quantum well structure for spectrally combining said different luminescent wavelengths into a broadband spectrum covering substantially a wavelength range from 1250nm to 1650nm.

~~the separate confinement hetero-structures located in the proximity of P-type semiconductor side includes an extremely thin N-type semiconductor, and wherein a width of the extremely thin N-type semiconductor is not greater than 5 nm and is used to prevent the dopant of the P-type semiconductor from penetrating into the quantum well structures8. The method according to claim 1 wherein the following arithmetic model is used to determine which carrier is the dominant carrier:~~

$$\cancel{\tau_{LF} = \tau_{p,diffusion} + \tau_{n,diffusion} + \tau_{cap,p} + \tau_{cap,n} = \frac{d_p^2}{4D_p} + \frac{d_n^2}{4D_n} + \frac{d_p \tau_{cp}}{W} + \frac{d_n \tau_{cn}}{W}}$$

~~where d_p and d_n respectively represents the distance that the hole or electron diffused to the quantum well, D_p and D_n represent the diffusion coefficients of semiconductor material, W represents the width of the multi-layer quantum well structures, $d_p \tau_{cp}$ and $d_n \tau_{cn}$ respectively represent the electron capture time and hole capture time according to the calculation result derived based on quantum physics, and •$_{p,diffusion}$, •$_{cap,p}$, •$_{n,diffusion}$, and $_{cap,n}$ respectively represent the diffusion time of the holes in the separate confinement heterostructure, the diffusion time of the electrons in the~~

~~separate confinement heterostructure, the equivalent hole capture time of the multi-layer quantum well structures, and the equivalent electron capture time of the multi-layer quantum well structures, and wherein an equivalent carrier capture time of the multi-layer quantum well structures is equal to the product of the carrier capture time of the multi-layer quantum well structures multiplied by a volume ratio of~~ $\cancel{d_p/W}$ ~~or~~ $\cancel{d_n/W}$~~.~~

(Currently Amended) 9. The method according to claim ~~8~~ 1 further comprising a step of ~~wherein~~:

using different materials for each of said layers of said multi-layer quantum well structure for providing said different luminescent wavelengths for spectrally combining said different luminescent wavelengths into a broadband spectrum.

~~the time associated with holes~~ $\cancel{\bullet_{p,total}}$ ~~is defined as the sum of the diffusion time of the holes in the separate confinement heterostructure plus the equivalent hole capture time of the multi-layer quantum well structures, and is compared with the time associated with electrons~~ $\cancel{\bullet_{n,total}}$ ~~being defined as the sum of the diffusion time of the electrons in the separate confinement heterostructure plus the equivalent electron capture time of the multi-layer quantum well structures.~~

(Currently Amended) 10. The method according to claim 9 1 further comprising a step of ~~wherein~~:

using different widths for each of said layers of said multi-layer quantum well structure for providing said different luminescent wavelengths for spectrally combining said different luminescent wavelengths into a broadband spectrum.

~~if $\bullet_{p,total} > \bullet_{n,total}$, electrons are sufficient to enter the two-dimensional energy level of the multi-layer quantum well structures earlier and thereby result in a higher electron density in the proximity of the N-type semiconductor side, and the holes that enters the two-dimensional energy level of the multi-layer quantum well structures later is similarly distributed according to the distribution of the electrons, so that the two-dimensional carrier distribution in the proximity of the N-type semiconductor side within the multi-layer quantum well structures is relatively high~~

(Currently Amended) 11. A semiconductor optical amplifier comprising ~~The method according to claim 9 wherein~~ :

a first and a second separate confinement hetero-structure (SCH) regions and a multi-layer quantum well structure comprising multiple layers each having a different luminescent wavelength disposed between said first and second SCH regions wherein said SCH regions having a reduced width whereby a time for capturing a hole carrier in said multi-layer quantum well structure is substantially equal to a time for capturing an electron carrier in said multi-layer quantum well structure.

~~if $\bullet_{n,total} > \bullet_{p,total}$, holes are sufficient to enter the two-dimensional energy level of the multi-layer quantum well structures earlier and thereby result in a higher hole density in the proximity of the P-type semiconductor side, and the electrons that enters the two-dimensional energy level of the multi-layer quantum well structures later is similarly distributed according to the distribution of the holes, so that the two-dimensional carrier distribution in the proximity of the P-type semiconductor side within the multi-layer quantum well structures is relatively high.~~

(Currently Amended) 12. The semiconductor optical amplifier ~~method~~ according to claim ~~9~~ 11 further comprising ~~wherein~~:

a barrier layer disposed between an upper quantum well layer of said multi-layer quantum well structure and a lower quantum well layer of said multi-layer quantum well structure having a different luminescent wavelength from said multiple layers of said multi-layer quantum well structure.

~~if $\bullet_{p,total} > \bullet_{n,total}$, holes are selected as the dominant carrier within the multi-layer quantum well structures, so as to obtain a temperature sensitivity and a better temperature coefficient due to the relatively large equivalent mass of holes.~~

(Currently Amended) 13. The semiconductor optical amplifier ~~method~~ according to claim ~~9~~ 11 wherein:

said first SCH region is disposed near a first semiconductor region of a first conductivity type and said second SCH region is disposed near a semiconductor of a second conductivity type opposite said first conductivity type.

~~if $\bullet_{n,total} > \bullet_{p,total}$, electrons are selected as the dominant carrier within the multi-layer quantum well structures, so as to obtain a relatively uniform carrier distribution within the multi-layer quantum well structures and a relatively larger gain bandwidth.~~

(Currently Amended) 14. The semiconductor optical amplifier ~~method~~ according to claim ~~1~~ 11 wherein:

said different luminescent wavelengths for each of said multiple layers of said multi-layer quantum well structure are provided for spectrally combining into a broadband spectrum covering substantially a wavelength range from 1250nm to 1650nm.

~~the photoelectric semiconductor device is one of a semiconductor optical amplifier, a superluminescent diode, and a semiconductor laser, and is adapted for III-V semiconductors used in an optical communication system.~~

(Currently Amended) 15. The semiconductor optical amplifier ~~method~~ according to claim ~~1~~ 11 wherein:

each of said layers of said multi-layer quantum well structure having different widths for providing said different luminescent wavelengths for spectrally combining said different luminescent wavelengths into a broadband spectrum.

~~the separate confinement heterostructure is formed from one group of II-VI semiconductors, III-V semiconductors, and IV semiconductors, combinations of II-VI semiconductors, III-V semiconductors, and IV semiconductors, and optionally includes a plurality of chemical elements.~~

(Currently Amended) 16. The semiconductor optical amplifier ~~method~~ according to claim ~~1~~ 11 wherein:

each of said layers of said multi-layer quantum well structure having different materials for providing said different luminescent wavelengths for spectrally combining said different luminescent wavelengths into a broadband spectrum.

~~the multi-layer quantum well structures are formed from one group of II-VI semiconductors, III-V semiconductors, and IV semiconductors, and optionally includes a plurality of chemical elements.~~